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(54) Title of the invention: Resin composition and optical products

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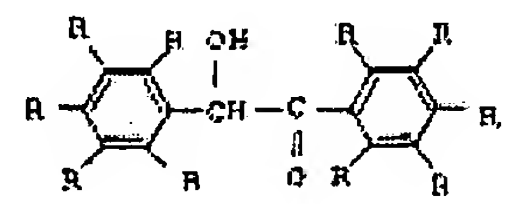
Details

Title of the invention

Resin composition and optical products

Scope of the claims

(1) A resin composition made from polyphenylene ether and a styrene polymer that contains 0.01 ~ 10 parts by weight of the compound represented by the formula shown below as an effective component, per 100 parts by weight of polyphenylene ether.



(Where, R represents –H or-CH_3)

(2) Resin composition mentioned in claim (1) above, which contains 1 ~ 60 weight % polyphenylene ether and 99 ~ 40 weight % of styrene polymer.

(3) Resin composition mentioned in claim (1) above, in which the compound mentioned above is α-hydroxybenzylphenylketone.

(4) Optical products made from the resin composition mentioned in claims (1), (2) or (3) mentioned above.

(5) Optical products mentioned in claim (4) above, in which the disk is a photo magnetic disk substrate.

Fields of industrial usage

This invention is concerned with a resin composition with high optical transparency and low double refraction and, optical products of this resin composition such as optical disk substrate, optical lenses, optical fibers and prisms.

Conventional techniques

Properties like excellent optical transparency, low double refraction, having a certain specific refractivity, thermal resistance, moldability and low absorption of moisture are required from optical disk substrate or lenses, and mainly thermoplastics like poly methyl methacrylate and polycarbonate are used for this purpose.

On the other hand, resin composition having low double refraction and made from polyphenylene ether and polystyrene is mentioned in American patent No. 4,373,065. According to that patent, a resin composition with low double refraction can be obtained by mixing polyphenylene ether having positive optical anisotropy with polystyrene having negative anisotropy.

Similar resin compositions have been reported in Patent No. JP62-240901 and JP63-86738.

However, in case of such resin compositions made from polyphenylene ether and polystyrene, the double refraction is low but it has a light-brown color and therefore, it cannot be used in optical disk substrate or optical lenses where excellent transparency is required.

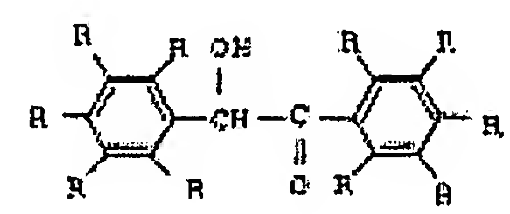
As stated above, since the resin composition showing low double refraction has a light brown color, it cannot be actually used where transparency is essential.

The present invention considered the above problem. Its objective was to present a resin composition made from polyphenylene ether and styrene polymer and a specific compound, and having high transparency and low double refraction. It also presents optical molded products of this resin such as optical disk substrate, optical lenses, optical fiber and prisms.

The problems this invention sought to solve

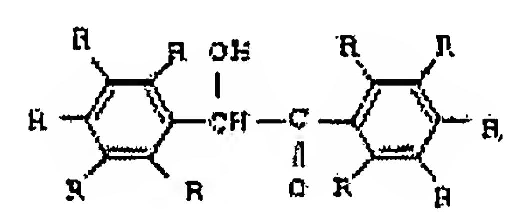
The present inventors conducted intensive research to solve the above problems and found that a resin composition obtained by adding a specific compound in specific proportion to a composition made from polyphenylene ether and styrene polymer and, molded optical products of this composition have high optical transparency and low double refraction and this led to the present invention.

Thus the first invention is a resin composition made from polyphenylene ether and styrene polymer and containing 0.01 ~ 10 parts by weight of the compound of the following general formula, per 100 parts by weight of polyphenylene ether.



(Where, R stands for –H or $-CH_3$)

The second invention is optical product made from the resin composition composed of polyphenylene ether and styrene polymer and containing 0.01 ~ 10 parts by weight of the compound of the following general formula per 100 parts by weight of polyphenylene ether.



(Where, R stands for –H or $-CH_3$)

Polyphenylene ether used in the resin composition and in the optical products of this invention is a polymer that can be obtained by the polymerization of phenol monomer by oxidative coupling. It can be obtained easily by the method mentioned in patents JP47-36518 and JP60-46129. Specific examples of polyphenylene ether are poly (2,6-dimethyl-1,4-phenylene) ether, poly (2-methyl-6-ethyl-1,4-phenylene) ether, poly (2-methyl-6-propyl-1,4,-phenylene) ether, poly (2-methyl-6-bromo-1,4-phenylene) ether, poly (2,6-dipropyl-1,4-phenylene) ether, poly (2-ethyl-6-propyl-1,4-phenylene) ether,

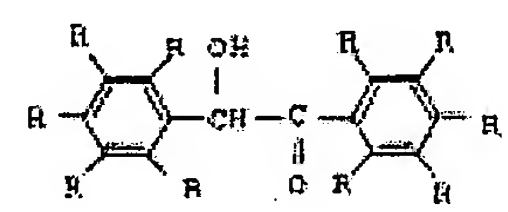
poly (2,3,6-trimethyl-1,4,-phenylene) ether. Especially poly (2,6-dimethyl-1,4-phenylene) ether is desirable. As regards polyphenylene ether, the one having limiting viscosity in the range of 0.3 ~ 0.6 at 25°C in chloroform is desirable.

In this invention, polystyrene polymer means a copolymer of styrene monomer and a small amount of monomer that can be co-polymerized with styrene. It can be easily obtained by block polymerization, suspension polymerization and emulsion polymerization. Here, examples of monomers that can be co-polymerized with styrene are styrene monomers like α-methylstyrene, chlorostyrene; methacrylic acid esters like methyl methacrylate, n-propyl methacrylate, cyclohexyl methacrylate; unsaturated nitriles like acrylonitrile, methacrylonitrile; maleic anhydride, citraconic anhydride and N-substituted maleimides like N-phenyl maleimide, N-methyl maleimide, N-methyl phenyl imide, N-cyclohexyl maleimide or imide of polymerized maleic anhydride. The desirable ones are polymerized styrene monomer or styrene copolymers containing from 0% to maximum 5 % of monomer that can be co-polymerized with styrene. Desirable value of weight average molecular weight of such styrene polymer is in the range of 70,000 ~400,000. In case of the resin composition made from a polymer with its weight average molecular weight of less than 70,000, the molding property is not sufficient. On the other hand, if the molecular weight exceeds 400,000, the molding property is not good.

It is better that the resin composition made from polyphenylene ether and styrene polymer contains 1 ~ 60 weight % polyphenylene ether and 99 ~ 40 weight % styrene polymer. If polyphenylene ether is more than 60 weight %, there is a possibility of double refraction and optical transparency reduces. Further, if styrene polymer is more than 99 weight %, double refraction is likely to occur. Actually the composition of these can be decided according to the objective. For example, in an application if some amount of reflection of heat is required at the cost of transparency, then a resin composition with larger proportion of polyphenylene ether (which has higher glass transition temperature than polystyrene) is preferred. Thus the composition with proportion of polyphenylene ether in the range 40 ~ 60 weight % and that of polystyrene in the range of 60 ~ 40

weight % is desirable. On the other hand, in case of lenses, where one cannot compromise for transparency even to a small extent, the desirable proportion of polyphenylene ether is in the range of 1 ~ 40 weight % and that of polystyrene is in the range of 99 ~ 60 weight %. Further, the molded product of this resin composition can be easily made by the well known method like mono-axial or bi-axial extrusion molding, open roll or Banbury mixer or, by dissolving in a common solvent like methylene chloride followed by drying or conducting radical polymerization of styrene and a monomer that can co-polymerize with styrene in presence of polyphenylene ether.

The compound that can be used in this invention is represented by the following general formula.



(Where R stands for –H or –CH_3). Specific examples of such compound are α-hydroxymethylbenzyltouyl and α-hydroxymethylbenzylphenyl ketone. These can be easily synthesized by benzoin condensation of corresponding aromatic aldehyde. Out of these, α-hydroxybenzylphenylketone and α-hydroxybenzyltoluyl are desirable.

It is essential that the proportion of such compound is 0.01 ~ 10 parts by weight per 100 parts by weight of polyphenylene ether in the resin composition made from polyphenylene ether and styrene polymer. If this proportion is less than 0.01 parts by weight, the optical transparency reduces. If, however, the proportion exceeds 10 parts by weight, it is difficult to get good results as regards transparency and 'bleeding' from the resin surface may occur and it is undesirable. The composition is thus in the range of 0.5 ~ 7 parts by weight and still desirable composition is in the range of 1 ~ 5 parts by weight. This compound may be added while preparing the mixture of polyphenylene ether and styrene polymer mentioned above.

Further, antioxidants like phosphite esters from tributyl phosphite, triphenyl phosphite, tricresyl phosphite or hindered phenols, hindered amine or epoxy resins or stabilizers can be added.

Application examples

This invention is explained below by giving application examples. It is, however, not restricted to these examples. In these examples, % means weight %.

Application example 1

40% of polyphenylene (2,6-dimethyl-1,4-phenylene) ether (of limiting viscosity 0.52) obtained by polymerization of 2,6-xylenol by using manganese chloride and ethanolamine as the catalyst, by the method mentioned in application example 2 No. 9 of Patent No. JP47-36518 and 60% of styrene polymer (Tenkastyrol HRM 2, Manufactured by Electrochemical Industries) and 1 part by weight (as against 100 parts of polyphenylene ether) of α-hydroxy benzylphenylketone (Wako Pure Chemicals) were mixed by fusing and then palletized by means of mono-axial extrusion machine.

With these pellets, an optical disk substrate (with spiral spring loop. Group shape: pitch 1.6 μm, width 0.7 μm, depth 0.07 μm) of thickness 1.2 mm, diameter 130 mm was prepared by means of precision molding injection molding machine [IS-50 EPD (50 ton) Manufactured by Toshiba] and the transparency of light at position of 50 mm radius (wavelength 830 nm) and double refraction (Automatic Ellipsometer manufactured by Mizoshiri Kogaku) were measured. The results are presented in the table.

Application examples 2 ~ 6

By using polyphenylene ether, styrene polymer and α-hydroxybenzylphenyl ketone similar to those in application example 1, pelletization of the fused mixture was carried out with a composition shown in the table, to obtain an optical disk. Then the items similar to those in application example were evaluated.

Comparison examples 1 ~ 2

By using polyphenylene ether and styrene polymer similar to those in application example 1, the above properties of the blended system were evaluated with the compositions shown in the table.

As can be seen from the table, the optical disks prepared in application example 1 ~ 6 have excellent transparency and show less double refraction. The resin composition of comparison examples 1 and 2 prepared by the conventional method show lower transparency for light. The composition of comparison example 3 the one with 12 parts by weight of α-hydroxy benzylphenylketone shows higher transparency for light but bleeding of α-hydroxybenzylphenylketone occurred at its surface.

On the optical disk obtained in application examples 1 ~ 6 and comparison examples 1 and 2 (production was not possible in comparison example 3), an amorphous optical magnetic medium film of terbium/iron of thickness 0.1 μm was prepared and C/N ratio of recording replay (Nakamichi Co., optical magnetic disk evaluation machine, model OMS-2000) was measured. The results are shown in the table.

From the table it is clear that the C/N ratio of the optical magnetic disk is high and the double refraction is also low, and thus it is excellent.

Table

	Application example						Comparison Example		
Resin									
Polyphenylene ether	40	40	40	50	50	50	40	50	50
Polystyrene	60	60	60	50	50	50	60	50	50
α-hydroxy benzylphenyl ketone (Per 100 parts by weight of polyphenylene ether)	1	2	4	1	2	4	0	0	12
Optical transparency (%)	84	86	90	83	85	89	81	79	90
Double refraction (nm)	+2	+3	+2	+20	+24	+20	+3	+20	+22
C/N (dB)	50	51	54	45	46	48	42	39	-

Effect of the invention

As stated above, the resin composition and product of the resin composition has high optical transparency and low double refraction. Due to its low double refraction, it is very useful in optical disk and lenses.